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### INDUSTRIAL USES FOR SILVER

In Technical News Bulletin 244 (August 1937) there appeared an outline of the research program sponsored by a group of leading American silver producers to develop new industrial uses for silver.

Since appointment of the last of the 15 research fellowships at the various laboratories engaged in this investigation about the first of June 1937, there has been an active study made along the various lines mapped out in the earlier report on this project. Definite progress has been made in each field studied, and, in several instances, indications are that the particular researches will, when completed, be of considerable interest to industry.

At one institution a Silver Research Project Fellow has been investigating the antifriction properties of silver and silver-rich alloys. Amsler wear tests evaluate the load which produces a given coefficient of friction and give information regarding the tendency of the

alloy to gall and score a steel journal. The effect on the antifriction qualities of a great many elements added to pure silver has been determined. Pure silver has been found exceptionally qualified for use as a bearing material, most alloy additions producing inferior results. The data being obtained are of special interest because steel-backed bearings lined with nearly pure silver have come into commercial use within the year, being standard equipment on certain aviation engines. Because of the resistance silver offers against galling and scoring, it is being considered for shims and metallic packing. The latter application takes advantage, also, of the resistance of silver to heat and corrosion.

Two research investigators studying the electrodeposition of silver and of silver alloys have developed methods for obtaining adherent deposits on steel and for codeposition of a number of elements with silver. The development of further improvements in electroplating technique is expected to ex-

<sup>1</sup> Published with approval of the Director of the Budget.

tend materially the usefulness of silver plating in the chemical and other industries.

The study of silver slip rings and silver-graphite brushes for rotating electrical contacts has demonstrated marked advantages for these materials over carbon or copper-graphite brushes, and copper slip rings or commutators. Contact voltage drop is very much less, operation follows the Ohm's law relationship closely, and much higher current densities can be tolerated. Furthermore, there is much less polarity effect when using the silver contacting surface. Manufacturers of electrical equipment have already taken cognizance of these test results, which may lead to improved design in certain electrical equipment.

Very satisfactory results have been obtained with silver as a catalyst in the oxidation of ethyl alcohol, operating at conditions varying considerably from commercial practice.

Data are being obtained on heat transfer through silver. The use of a commercial 50-gallon vessel of pure silver has reduced a batch operation cycle from 48 hours when carried out in glass-lined equipment to only 4 hours, with an increase in thermal economy and with less degradation of the product. Scientific data on such performances are, however, lacking, and it is believed that this research will contribute heat-transfer data of use to the mechanical and chemical engineer.

The ability of silver salts to act as potent fungicides has been demonstrated by a Silver Research Project Fellow and the agricultural possibilities are being studied in some detail. This research also appears very promising in connection with water sterilization, particularly for fish hatcheries.

A thorough study of the medical literature on argyria, or alleged silver poisoning, has been made as a preliminary step by the Research Fellow investigating the toxicological properties of silver. Very little reliable information on this subject is available, and further study is needed to evaluate the extent to which this may be a problem of practical interest to other than the medical profession. Another research worker in the medical field is studying the "mechanism" of the action of silver on bacteria by determining what particular chemical group of the organism reacts with silver or the silver ion.

The permeability of hot silver to oxygen has been considered as a means of fractionating air. Calculations show

interesting possibilities, and experimental work is being undertaken to verify the calculations and the practicability of using this principle in enriching blast-furnace air, for example. The solubility of oxygen in molten silver offers another possible line of attack, and this also is being considered.

The effect of additions of silver in small amounts (up to about 5 percent) to the engineering alloys is being studied on a comprehensive scale through cooperation of five men working at three different institutions. These same research workers are also noting the effect of small additions of other metals to pure silver. In general, the response to various annealing and hardening treatments and to corrosion is being studied. It is expected that data will also be obtained on castability, mechanical properties, electrical conductivity, and other properties likely to be of special interest. Almost 200 alloys have been prepared for this work.

Special attention is being devoted to the lead-silver solders containing from about 2 to 6 percent of silver, with and without other additions, as competitors with the lead-tin solders and as intermediate temperature solders. Long-time creep-test data are being obtained on soldered joints made with such alloys, at both room and elevated temperatures.

Another investigation sponsored by this project has to do with the effect of silver additions to storage-battery grids.

Technical data are being gathered on all silver-alloy systems, the patent literature dealing with silver, and the use of silver in the chemical industry.

A. J. Dornblatt, senior research associate at the National Bureau of Standards, representing the American Silver Producers, has recently visited some 60 companies and research laboratories to acquaint them with the objectives of the various researches, and the results being obtained on this project, and to solicit suggestions and data from their staffs. Parties interested in any phase of the American Silver Producers' cooperative research are invited to correspond with the Bureau for details.

#### INTERFERENCE MEASUREMENTS IN THE FIRST SPECTRA OF NEON, ARGON, AND KRYPTON

Precisely determined wave lengths of certain homogeneous radiations, so-called spectral lines, have two important uses as standards. The first is their metrological application in the accurate comparison and determination of gages and standards of length.

Michelson's determination of the meter in terms of the red radiation of cadmium nearly half a century ago first proved the feasibility of using light waves in the calibration of length standards. Recognition of the invariant character of the wave lengths of selected radiations has led to a widespread application of the method. In addition to the cadmium lamp, other light sources (particularly Geissler tubes filled to pressure of a few millimeters of mercury with krypton, argon, or neon, which give spectra consisting of exceedingly sharp lines) have been found useful. Selected lines from these spectra, under easily controlled operating conditions, are reproducible to 8 significant figures. Precision of measurement attainable under the best conditions is of the same order.

The second field of application of precisely determined wave lengths is their use as standards for spectroscopic measurements. The first optical wave-length measurements were obtained with diffraction gratings from a knowledge of the grating space and the geometry of the setup. Rowland perfected the method and obtained a set of standards of high quality but still subject to certain errors inherent in grating determinations. The evaluation of the meter by means of the interferometer in terms of the cadmium red line was the starting point for the present system of standards. Determinations by Benoit, Fabry, and Perot, some years after Michelson's first measurements, gave a value of 6438.4696 Å for the wave length of this radiation. This value has been adopted as a definition of the primary standard for wave-length measurements. Accurate spectrographic comparisons of wave lengths require a large number of standards distributed at regular intervals throughout the range of observation. These standards are determined by interferometric comparison either with the primary cadmium radiation or with groups of lines which have been so compared with such accuracy that no error in scale can arise.

The International Astronomical Union sponsors the specification and adoption of these standards. A prerequisite to the adoption of any radiation as an international secondary standard is that there must be three independent concordant observations. Standards so far adopted include 20 lines each of krypton and neon, all in the visible region, and 244 iron lines extending throughout the visible region down to 3370 Å in the ultraviolet.

The demand for increased precision of wave-length measurements, which is essential to further progress in the theoretical analysis of spectra, has led to an intensive investigation of various sources of radiation as possible standards. The need for standards is particularly apparent in the ultraviolet region. The spectra of neon, argon, and krypton contain a number of lines of moderate intensity in the ultraviolet. The precise determination of the wave lengths of these lines was the principal object of an investigation by Curtis J. Humphreys of the Bureau's spectroscopy section, which will be published as RP1061 in the January number of the Journal of Research. The intense visible blue and violet argon lines were also measured, inasmuch as sufficient number of independent determinations were not available.

The adopted krypton secondary standards were used throughout the investigation, being most satisfactory from an experimental viewpoint for work in the violet and ultraviolet region.

The Fabry-Perot interferometer as used in these experiments consists of a pair of crystal quartz plates, each having a very accurately figured plane surface coated with a semi-transparent layer of aluminum by the method of evaporation in a vacuum. These surfaces are held apart and kept parallel by a separator or etalon consisting essentially of 3 invar pins of equal length. The interference patterns obtained by illuminating this system are focused upon the slit of a spectrograph, which, because of its dispersion, disentangles the images originally superposed and permits photographing a separate pattern for each wave length.

The theory of the interferometer is based on the simple assumption that the distance between the surfaces is given by the product of the wave length of a given radiation or spectral line by the number of waves contained in this interval, known as the interference path, and that this is true of any part of the spectrum. The problem of wave length comparisons consists essentially in the determination of the plate separation from the measurements of the interference patterns of a set of standard lines, after which the number of waves in the interference path for any radiation can be determined from a satisfactory preliminary value of the wave length and the geometry of the interference pattern. When this number of waves,

always consisting of a whole number and a fraction, is found, it is divided into the distance between the plates to give the precisely determined wave length.

The results of this investigation include wave-length determinations of 27 neon lines, 40 argon lines, and 37 krypton lines. The relative accuracy of the wave lengths compares favorably with that of the adopted standards, being of the order of 1 part in 10,000,000.

#### INFRARED SPECTRA OF IRON, TITANIUM, AND CARBON

New wave lengths in the arc spectra of iron and titanium have been recorded photographically by Carl C. Kiess of the Bureau's spectroscopy section, using the type Z plates produced by the Kodak Research Laboratories. As reported in the Journal of Research for January (RP1062), the long wave-length limits of these spectra have now been extended to the vicinity of 12,000 Å. Many of the observed lines were predictable from previously known terms. Several apparently related groups of lines in titanium have revealed a new term belonging to the third set, and combining with terms of the middle set. Previously known lines in the spectrum of carbon have been photographed with high dispersion to obtain accurate wave-length values for use in identifying infrared lines in the sun's spectrum. A new band in the infrared system of cyanogen has been found.

#### $\alpha$ - $d$ - $\beta$ -MANNOHEPTOSE

The preparation by Horace S. Isbell of a new sugar,  $\alpha$ - $d$ - $\beta$ -mannoheptose, is described in an article to appear in the Journal of Research for February. The sugar crystallizes as a monohydrate which melts at 83° C, gives an initial specific rotation of +45.7, and exhibits a complex mutarotation which can be represented by the following equation:

$$(\alpha)_{\text{D}}^{20} = 14.5 + 8.3 \times 10^{-0.0141t} + 22.9 \times 10^{-0.0016t}$$

The sugar was obtained by the reduction of the gamma lactone of  $d$ - $\beta$ -mannoheptonic acid and was separated in the form of prismatic crystals which melted at 130° C and which gave a specific rotation  $(\alpha)_{\text{D}}^{20} = -35.7$ .

The new sugar is structurally related to  $\alpha$ - $d$ -talose and exhibits similar properties. Oxidation measurements with bromine water show that  $\alpha$ - $d$ - $\beta$ -mannoheptose is oxidized at a rate comparable to that found for the oxida-

tion of  $\alpha$ - $d$ -talose and that aqueous solutions of the sugar contain substantial quantities of more rapidly oxidizable modifications. The parallelism between the properties of  $\alpha$ - $d$ -talose,  $\alpha$ - $d$ - $\alpha$ -guloheptose, and  $\alpha$ - $d$ - $\beta$ -mannoheptose is evidence that the configuration of the five carbon atoms comprising the pyranose ring determines in large measure the composition of the equilibrium solutions of the sugar.

#### EXHIBIT OF RARE SUGARS

At the meeting of the American Association for the Advancement of Science held in Indianapolis, December 27-30 inclusive, the Bureau's polarimetry section exhibited a collection of rare sugars which is unique in that it includes all of the pentose, hexose, and heptose aldose sugars of the  $d$  configurational series, which are known products at the present time. These sugars have been prepared by various members of the staff without seed crystals from other sources. The group comprises 4 pentoses, 8 hexoses, and 8 heptoses, all of which are in the crystalline state with the exception of  $d$ -idose, which has never been crystallized. The following sugars in the collection were crystallized for the first time at the Bureau:

- $d$ -Allose.
- $d$ - $\beta$ -Glucoheptose.
- $d$ - $\alpha$ -Guloheptose.
- $d$ -Gulose  $\text{CaCl}_2$ .
- $d$ - $\beta$ -Mannoheptose.

#### A LABORATORY EXTRACTION APPARATUS

RP1067 in the January number of the Journal of Research describes a glass laboratory extraction apparatus designed by S. T. Schickltanz, formerly with the research group of the American Petroleum Institute, at the Bureau. This apparatus operates with reflux, for use with solvents heavier than the liquids to be extracted. The paper gives data on the extraction, with acetic acid, of a narrow-boiling fraction of "water-white" lubricating oil.

#### WATER TOLERANCES OF MIXTURES OF GASOLINE WITH ETHYL ALCOHOL

During recent years the interest in the use of mixtures of gasoline with ethyl alcohol as engine fuels has increased because of the desire to provide an outlet for agricultural products which can be converted into ethyl alcohol. One of the major difficulties in connection with the use of this type of fuel is that only a very small amount of water may cause the mixture to separate into two layers.

The temperature at which separation occurs depends upon the particular gasoline and upon the proportions of gasoline, ethyl alcohol, and water in the mixture. In a previous investigation, data were obtained on the separation temperatures of mixtures in various proportions of 23 different gasolines with ethyl alcohol containing various percentages of water. From these data, it is easily possible to obtain the water tolerances of any of these gasolines at any given temperature within the range investigated. Analysis of the water tolerance values indicated certain similarities in the trend of water tolerance with composition of the mixtures when comparing the results with different gasolines. This suggested the possibility of deriving a general empirical equation for the water tolerance of mixtures of gasoline and ethyl alcohol and of assigning to any gasoline a characteristic constant which would be indicative of the water tolerance of any mixtures of this gasoline with ethyl alcohol.

The derivation of this empirical equation and the characteristic constants as calculated for each of the 23 gasolines are set forth in RP1059 by Oscar C. Bridgeman and Elizabeth W. Aldrich in the January number of the Journal of Research. The difference between the experimentally determined separation temperatures and those calculated from the equation was on the average  $1.4^{\circ}\text{C}$ , and the difference between observed and computed water tolerances was about 0.005 percent of the total mixture.

The equation which has been developed makes possible the calculation of the water tolerances of mixtures of any gasoline with any percentage of ethyl alcohol from measurements of the separation temperatures of a few mixtures of known composition of this gasoline with ethyl alcohol.

#### CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF GASOLINE, *n*-PROPYL ALCOHOL, AND WATER

If methyl alcohol were used in a gasoline-alcohol engine fuel, the amount of water which would cause separation of the mixture into two liquid layers would be even smaller than if ethyl alcohol were used. On the assumption that mixtures of the higher aliphatic alcohols with gasoline might have a greater water tolerance, an investigation was undertaken by Elizabeth W. Aldrich, of the water tolerances and separation temperatures of mixtures of gasoline, some of the higher aliphatic alcohols, and water. The first

of these alcohols studied was *n*-propyl alcohol, and measurements were made of the temperatures of separation into two phases in solutions of known composition. For comparison, similar data were obtained on mixtures of the same gasolines with ethyl alcohol.

A comparison of the results, which are given in the Journal of Research for January (RP1060), showed that at all temperatures of practical interest, the water tolerances of mixtures of gasoline with *n*-propyl alcohol are greater than those of mixtures of gasoline with ethyl alcohol containing the same percentage of alcohol. However, when the mixture contains *n*-propyl alcohol, if separation occurs below approximately  $-15^{\circ}\text{C}$ , the second phase is solid, or if separation occurs above this temperature, the liquid which separates will freeze if lowered to this temperature. Although the greater water tolerances of mixtures of gasoline with *n*-propyl alcohol give them an advantage over mixtures with ethyl alcohol if used as engine fuels, consideration must be given to the possible disadvantage of the formation of solid material which does not occur in mixtures with ethyl alcohol.

#### PERFORMANCE CHARACTERISTICS OF VENTURI TUBES

Venturi tubes are used in many airplanes to furnish the suction for operating air-driven gyroscopic instruments. While the operating efficiency of Venturi tubes is low as compared to vacuum pumps, their cheapness and mechanical simplicity have furthered their continued use in many installations. The lack of data on the performance and design of Venturi tubes used as vacuum pumps has made it desirable to undertake an experimental study of their performance and design characteristics. As part of this study, Harcourt Sontag and Daniel P. Johnson, of the Bureau's aeronautic instruments section, have determined the performance characteristics of commercially available Venturi tubes, and these characteristics are presented in Technical Note 624 just released by the National Advisory Committee for Aeronautics. The investigation was made with the cooperation and financial support of the Committee.

Tests were made in a wind tunnel and in flight to determine the performance characteristics of three samples each of two designs of Venturi tubes now used in airplanes to operate air-driven gyroscopic instruments. In the tests, the variation of the suction developed at the venturi inlet with the



air flow, the speed, and air density were measured; also the drag and the effect of pitch and yaw. Rather large variations of the suction, drag, and efficiency were found between individual tubes of the same design. Cylindrical fairing on the external surface of a Venturi tube resulted in a reduction of drag and suction at a given air speed but produced no appreciable change in efficiency.

For constant values of the ratio of suction to atmospheric pressure, the air flow is approximately a linear function (independent of altitude for a double venturi tube) of the product of the indicated air speed and the square root of the ratio of standard air pressure to the atmospheric pressure. Consequently, data obtained at sea level may be used to make approximate predictions of performance at higher altitudes. There is some indication that this may also be done for single Venturi tubes.

For a given installation in which an air-driven instrument is connected through tubing with a Venturi tube, the volume rate of induced air flow is approximately proportional to the product of indicated air speed and the square root of the ratio of standard to ambient air pressure. The efficiency of such a system at a given altitude is constant.

#### DETERMINATION OF ALTITUDE OF STRATOSPHERE BALLOONS

The altitudes above sea level of the gondola of the stratosphere balloons piloted by Kepner, Stevens, and Anderson in the flight made on July 28, 1934, and by Stevens and Anderson on November 11, 1935, were determined by two independent methods. In the first method, data on air pressure and air temperature were obtained in flight by means of recording instruments, and the altitude was computed using the commonly accepted barometric formula. In the second method, photographs were taken vertically below the balloon at intervals of about 90 seconds; from a knowledge of the focal length of the camera lens and from measurements on the film of the distance between landmarks (for which the distance apart on the ground and the elevation above sea level were available from surveys) the altitude was readily computed.

In the 1935 flight, Hemple obtained altitudes of the balloon from measurements of the vertical angles from a network of ground stations.

Considering the 1934 flight results, for 32 comparisons in the range from

42,000 to 62,000 feet above sea level, the average difference in the altitude by the two methods was 0.7 percent without regard to sign, and on the average the barometric altitude was 30 feet higher than the photogrammetric.

For the 1935 flight, for 60 comparisons in the range from 59,000 to 72,000 feet above sea level, the average difference was 0.36 percent without regard to sign and the barometric altitude was 93 feet lower, on the average. The altitudes obtained by vertical-angle measurement and by the other two methods were also in satisfactory agreement.

#### ODOROUS FUMES FROM SULPHATE PULP MILLS

The sulphate process of cooking wood for pulp involves the formation of gases and easily volatile substances that are characterized by extremely offensive odors. The malodorous substances are heavier than air, and are obnoxious in very low concentrations; hence, if they are permitted to escape to the atmosphere, the offending mill becomes a nuisance in the community. Letter Circular LC508, which has just been prepared by C. G. Weber of the Bureau's paper section, discusses briefly the nature of the malodorous substances, their formation in the process, and the steps necessary for their collection and destruction to minimize the escape of odors. The Letter Circular will be sent without charge to anyone directly concerned with the elimination of offensive odors from kraft mills.

#### VOLUMETRIC DETERMINATION OF CELLULOSE IN PULPS AND PAPERS

Alpha-, beta-, and gamma-cellulose are terms used in paper chemistry to designate the analytical fractions of cellulose. The amount of each fraction present varies widely among the various cellulose materials. A high content of alpha-cellulose generally indicates good quality although no such significance for the other fractions has, as yet, been found. The amount of cellulose which can be filtered out of a mixture of the ground material and a solution of sodium hydroxide is a measure of the alpha-cellulose content. Since none of the existing methods for measuring this important quantity is simply applicable to all types of pulps and papers, the Bureau developed the modified volumetric method described in J. Research NBS 18, 333 (March 1937) RP979.

In the January number of the Journal of Research (RP1068), Herbert F.

Launer shows that the volumetric method, which is based upon the oxidation of each fraction by dichromate solution, is simple and rapid, not only in the separation of the fractions but also in their estimation. He found that sizing materials, such as rosin, glue, and starch, could be corrected for, and that the effect of materials such as lignin and zinc sulphide could be eliminated without analyzing for them, thereby avoiding extremely tedious and time-consuming determinations.

The method is shown to be applicable to a wide range of materials. The samples analyzed were sulphite pulp and papers made from various materials including No. 1 new white shirt cuttings, a mixture of No. 1 old white rags and bleached colored rags, a mixture of soda and sulphite pulps, a mixture of rags and sulphite pulps, unbleached sulphate pulp, sulphite pulp, and newsprint paper.

It was found, in agreement with the results of previous workers, that small, practically constant amounts of sizing materials remain with the alpha-cellulose.

The dichromate equivalents for papermakers' rosin, glue, and starch were determined under test conditions. The dichromate equivalent for cellulose was determined for the various materials and found to be in good agreement with the theoretical value.

#### PASSAGE OF MOISTURE THROUGH WRAPPING MATERIALS

Some wrapping materials, and other membranes as well, that are practically impermeable to air allow moisture to pass through them readily. Several explanations for this seemingly strange behavior have been advanced. A review of these explanations is given in an article prepared for publication in Food Industries by F. T. Carson, of the Bureau's paper section.

The article also discusses the influence of various factors in the testing of membranes for permeability to moisture. The amount of moisture that gets through a membrane depends upon the time it is exposed and upon its area and thickness. One of the most serious sources of error commonly encountered in testing for permeability to moisture is leakage. The driving pressure is determined by the vapor-pressure difference, or by the difference in the humidity conditions on the two faces of the membrane. The relative humidity, especially on the moist side, is an important factor. The atmospheric pressure, or barometric pressure, also has

an influence on the test, especially if different on the two faces of the specimen. The test is affected by the temperature and by the rate of diffusion of water vapor in still air. It may also be influenced by the state of the moisture (whether liquid or vapor) in contact with the membrane.

#### SIMPLIFIED PRACTICE RECOMMENDATION FOR ADHESIVE PLASTER

Simplified Practice Recommendation R85-37, the first revision of the program on adhesive plaster, became effective on December 15, 1937.

This recommendation covers a simplified schedule of stock widths and lengths of adhesive plaster in rolls and on spools. It was promulgated originally in September 1928, following a general conference of manufacturers, distributors, and users of adhesive.

To determine the basis for simplification, a survey of variety was made prior to the general conference by the Division of Simplified Practice, in cooperation with a standing committee of the industry. The survey disclosed that adhesive plaster was being manufactured in 26 sizes. After detailed discussion and consideration of the survey data, the general conference approved a schedule of 15 sizes as being adequate to supply all normal requirements. This represented an elimination of 11 sizes, or 42 percent.

The recommendation in its original form was reaffirmed in 1929, 1931, and 1934, by the standing committee of the industry. This committee was created by the general conference to keep the program abreast of changing conditions and new developments.

The current revision, which was approved by the standing committee in August 1937, concerns adhesive plaster in rolls, and provides for the addition of an item in active demand and the elimination of one in which consumption is negligible. No changes were proposed with respect to adhesive plaster on spools, and this part of the recommendation remains as originally drafted.

In addition to the schedule of stock widths and lengths of adhesive plaster, the revised printed issue will include a brief history of the development of the project, the present membership of the standing committee, and a list of acceptors of the recommendation.

Until the printed recommendation is available, free mimeographed copies may be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington, D. C.

#### SIMPLIFIED PRACTICE RECOMMENDATION FOR ASBESTOS PAPER AND ASBESTOS MILLBOARD

Simplified Practice Recommendation R19-37, the third revision of the recommendation entitled Asbestos Paper and Asbestos Millboard, became effective on December 15, 1937.

This program originally became effective September 1, 1924, following a preliminary conference of manufacturers in November 1923, and a general conference of all interests in May 1924, both held under the auspices of the Division of Simplified Practice. The development and adoption of a schedule of specific items for regular stock purposes resulted in reductions in varieties of asbestos paper and asbestos millboard, amounting to 86 and 81 percent, respectively.

Two tables, one showing weights, widths, and thicknesses of asbestos paper, in rolls; and the other, size and thicknesses of asbestos millboard, in sheets, are included in the simplified schedule.

Prior to the current revision, the recommendation was revised twice, in 1927 and 1928; and reaffirmed, in its revised form, in 1932 and again in 1935. The third revision concerns only table 2, and covers the addition of one thickness of asbestos millboard. The standing committee, which has the responsibility of maintaining the schedule abreast of changing conditions through revision, felt that its proposals for changes and their acceptance generally by manufacturers, distributors, and users, would result in increased adherence to the recommendation.

The new printed issue will include a brief history of the development of the project, and will list the present members of the standing committee and the acceptors of the recommendation.

Until printed copies are available, free mimeographed copies of the revision may be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington, D. C.

#### COLORS FOR KITCHEN ACCESSORIES

Difficulty in securing a satisfactory color match between articles purchased for use in kitchens, where color harmony is essential to pleasing appearance, has long been a source of inconvenience to purchasers. This difficulty is greatest when items made of different materials are produced by different manufacturers. Not only has this inconvenienced purchasers, but it has been a source of trouble and loss to producers and merchants through slow turnover, multiplicity of stock, excessive returns, and obsolescence.

At the instance of the National Retail Dry Goods Association, the Bureau circulated a draft for comment and conducted a general conference on April 30, 1937, of those directly concerned with kitchen accessories. At this conference a committee presented, on behalf of the National Retail Dry Goods Association, six colors that had been selected on the basis of greatest acceptance by purchasers, and the conference adopted these colors as recommended standards with the request that they be presented to the industry for acceptance.

Colors for Kitchen Accessories, Commercial Standard CS62-38, which is now available in printed form, lists the colors adopted, with numerical designations as follows: SKC-00, white; SKC-15, kitchen green; SKC-31, ivory; SKC-41, delphinium blue; SKC-45, royal blue; SKC-70, red.

The pamphlet includes a brief discussion of the most important principles underlying color comparisons and records a procedure based on those principles. It is not intended to discourage the introduction of new colors nor to restrict the production of goods in colors other than those selected as standard. It should be understood that manufacturers are free at all times to introduce other colors and merchants are at liberty to stock them.

For control of production and in order to make compliance comparisons, duplicate reference samples in the form of enameled-iron plaques, certified and distributed by the Bureau, are made available to producers, distributors, and users in sets of 10, which include the 6 colors adopted for kitchen accessories and the additional colors for bathroom accessories recorded as standard in a companion publication, Colors for Bathroom Accessories, Commercial Standard CS63-38.

In order that consumers may become familiar with standard colors and purchase the same with confidence, the standard includes a recommended method of identification by sticker, tag, or other label, securely attached to the article, bearing one of the following statements:

"The \_\_\_\_\_ Company certifies this to be Standard Color SKC-\_\_\_\_, in accordance with Commercial Standard CS-62-38, issued by the National Bureau of Standards, of the U. S. Department of Commerce."

Or

"Standard Color SKC-\_\_\_\_, \_\_\_\_\_ Company."



The pamphlet includes a tabular comparison between these colors and other standard colors, such as those for sanitary ware and bathroom accessories, with the corresponding designations in such color systems as Munsell, Ridgway, Maerz, and Paul, The Textile Color Card Association, and the Inter-Society Color Council. A brief history of the project and a condensed report of the general conference are also given. The standard is effective for new production from January 1, 1938.

Copies of CS62-38 are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents each.

#### COLORS FOR BATHROOM ACCESSORIES

The same reasons which led to the adoption of Commercial Standard CS62-38, Colors for Kitchen Accessories, resulted also in the formulation and acceptance by manufacturers, distributors, and users of a similar standard, CS63-38, covering colors for bathroom accessories. This standard, printed copies of which are now available, lists the colors adopted, with numerical designations as follows: SBC-00, white; SBC-12, bath green; SBC-20, orchid; SBC-31, ivory; SBC-35, maize; SBC-40, bath blue; SBC-45, royal blue.

Reference samples in the form of enameled-iron plaques, certified and distributed by the Bureau, are available to producers, distributors, and users in sets of 10 which include the 7 colors adopted for bathroom accessories and the additional colors for kitchen accessories.

The standard includes a recommended method of identification by sticker, tag, or other label, securely attached to the article, bearing one of the following statements:

"The ----- Company certifies this to be Standard Color SBC- , in accordance with Commercial Standard CS63-38, issued by the National Bureau of Standards, of the U. S. Department of Commerce."

Or

"Standard Color SBC- , ----- Company."

The pamphlet includes a tabular comparison between these colors and other standard colors, with the corresponding designations in such color systems as Munsell, Ridgway, Maerz, and Paul, The Textile Color Card Association, and the Inter-Society Color Council.

There is also included a brief history of the project and a condensed report of the general conference.

Copies of this standard, which is effective for new production from January 1, 1938, are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents each.

#### CONSISTENCY OF EIGHT TYPES OF VITREOUS ENAMEL FRITS AT AND NEAR FIRING TEMPERATURES

In the firing of a vitreous enamel on metal, it is desirable that the grains should fuse together and flow out smoothly at as low a temperature as possible. The adjustment of batch compositions to achieve acid resistance, high opacity, or other desirable characteristics may increase the temperature required for firing, and it is, therefore, important to correlate the composition of enamels with their consistency at and near firing temperatures. As the first step in such a correlation, W. N. Harrison, R. E. Stephens, and S. M. Shelton have tested eight vitreous-enamel frits, representing eight commercial types, in the temperature range 750 to 950° C, using a rotation viscometer. As reported in RP1063 in the January Journal of Research, the two first-coat frits behaved as viscous liquids, the shearing stresses at any given temperature being proportional to the rates of shear. Four of the cover-coat enamels behaved as complex liquids, the shearing stress increasing at increasing rates with rates of shear. Two cover-coat frits containing lead oxide behaved rather erratically.

The change of apparent viscosity with temperature was great in all cases, an increase of as much as a hundredfold being observed for a reduction of 200° C. At a single temperature, 839° C, the highest observed apparent viscosity was 28 times as great as the lowest. Two cover-coat frits, having a twelvefold difference in apparent viscosity at 850° C, had equal apparent viscosities when the temperature difference between these frits was 125° C, comparison being made at equal torque in the apparatus. The highest observed apparent viscosity was 61,000 poises, which was nearly 400 times greater than the smallest observed value of 155 poises.

#### SOME "SOFT" GLAZES OF LOW THERMAL EXPANSION

One result of the search for ceramic whiteware of high quality, to be produced at lower cost to the ultimate purchaser, has been the laboratory de-

velopment of bodies maturing at temperatures materially lower than those used in present commercial practice and characterized also by their relatively low thermal expansion. This has necessitated a search for glazes of similar properties in order to "fit" these bodies.

In the Journal of Research for January (RP1064), R. F. Geller, E. N. Bunting, and A. S. Creamer present the results of studies which they have just completed on compositions in the ternary field  $PbO-B_2O_3-SiO_2$  as potential glazes both with and without the addition of 5 percent of  $Al_2O_3$ . Compositions within a very small field (25 to 40 percent of  $PbO$ ; 15 to 30 percent of  $B_2O_3$ ; and 40 to 55 percent of  $SiO_2$ ) show promise as glazes for maturing below  $1,150^\circ C$  on tallose bodies of relatively low thermal expansion. Low resistance to solution by weak acids may limit their application to wares which do not come in prolonged contact with food.

#### GLASS CONTENT OF COMMERCIAL PORTLAND CEMENT CLINKER

The approximate glass content of commercial portland cement clinker, as determined by the heat of solution method, has been found to vary considerably in the clinker from different plants. By subjecting the clinker to special heat treatments in the laboratory, William Lerch, research associate at the National Bureau of Standards, representing the Portland Cement Association, found that the glass content of a given clinker composition is dependent on the rate of cooling of the clinker. Relatively large glass content may be obtained by cooling the clinker rapidly, and relatively small glass content may be obtained by cooling the clinker slowly. It seems probable that the variations in the glass content of commercial portland cement clinker, together with the changed compound composition resulting therefrom, may account for certain variations in the properties of cement which could not previously be accounted for on the basis of equilibrium composition alone. A complete account of this work will be published as RP1066 in the January number of the Journal of Research.

#### STRENGTH, WATER ABSORPTION, AND RESISTANCE TO FREEZING AND THAWING OF SAND-LIME BRICK

The American Society for Testing Materials' current Standard Specification for Sand-Lime Brick was written in 1929. At that time those interested in specifications for building brick were thinking almost wholly in terms of

strength. Strength of brick was regarded not only as a desirable property in itself but also as a measure of weather resistance. However, studies of clay and shale brick have shown that strength is not a clear-cut measure of weather resistance when a wide range of raw materials, such as clays and shales, are considered, and that there also exist other measures for this property. Among these are the ratio of cold-water absorption to absorption by boiling which serves to grade clay and shale bricks from the standpoint of weather resistance more effectively than either strength grading or water absorption alone.

From the standpoint of emphasis on durability grading, the question asked is, what changes should be made in the sand-lime brick specification? To provide an answer to this question, J. W. McBurney and A. R. Eberle of the Bureau's section on masonry construction have tested samples of sand-lime brick from 11 commercial plants. The data obtained included compressive strength (flatwise), modulus of rupture, water absorption by 24-hour cold immersion and 5-hour boiling, the ratio of these two absorption measures, the rate of absorption by 3-minute partial immersion in water, and the effect of 50 cycles of freezing and thawing measured both by loss in weight and change in compressive strength. Sieve analyses were made of samples of sands which the 11 plants used in making the bricks. The conclusions from these data, which will be set forth in detail in RP1065 in the January number of the Journal of Research, indicate that:

1. Comparison of compressive strengths of sand-lime brick from plants sampled in 1936 with the results of previous tests on brick from the same plant sampled in 1928 shows an average gain in compressive strength of 37 percent.
2. Neither water absorption by 24-hour cold immersion, nor by 5-hour boiling, is related to resistance to freezing and thawing.
3. The ratio water absorption by 24-hour cold immersion to water absorption by 5-hour boiling is not related to resistance to freezing and thawing.
4. There does not appear to be a consistent relation between rate of absorption and resistance to freezing and thawing.
5. A marked increase in compressive strength resulted from 50 cycles of freezing and thawing where the brick possessed originally compressive strengths greater than  $6,500 \text{ lb/in}^2$  or

moduli of rupture greater than 800 lb/in<sup>2</sup>.

6. Good correlation with resistance to freezing and thawing is given by the compressive strengths.

7. Correlation between resistance to freezing and thawing and modulus of rupture is excellent.

8. Complete disintegration occurred only on bricks made from a sand containing clay balls retained on a  $\frac{3}{8}$ -in. sieve.

9. Of 120 bricks subjected to 50 cycles of freezing and thawing, a limit of 10 percent loss in weight rejected 3 specimens, 3 percent loss in weight rejected 11 specimens, 3 percent loss in weight and more than 25 percent reduction in compressive strength rejected 23 specimens, and a limit of 1 percent loss in weight and 25 percent loss in compressive strength rejected 34 specimens.

10. Of 43 bricks grading A under the current American Society for Testing Materials Specification C73-30 for Sand-Lime Brick, 41 passed and 2 failed when subjected to 50 cycles of freezing with the requirement of not losing more than 1 percent in weight or more than 25 percent in compressive strength. Of 71 bricks grading B, 45 passed and 26 failed by the same requirement. Of 6 bricks grading C, all failed. Had the requirement given in the specification under the "Inspection and Rejection" clause, which provides that the bricks "shall be free from \* \* \* balls of clay \* \* \* that would affect their serviceability or strength" been applied, the showing of the B grade would have been much better.

Since resistance to freezing and thawing is best correlated with strength, the Bureau's recommendation is to regard the strength classification of the current specification for sand-lime brick as a weathering classification. A tightening of the "Inspection and Rejection" clause is desirable.

#### PERFORMANCE TESTS OF MATERIALS FOR LOW-COST HOUSE CONSTRUCTION

In connection with the new research program on building materials and structures with special reference to low-cost housing, the Bureau is attempting to develop performance tests for walls, partitions, floors, and roofs. Such tests of new constructions made according to a uniform procedure as to size of specimen and test methods, along with the results of similar tests on conventional constructions, should form a more reasonable basis for judging the value of the former than any method now available. Ultimately,

such performance tests may find their way into building codes to replace present requirements which specify details of sizes of members for use in conventional types of construction. Adequate performance requirements will, it is hoped, facilitate the rapid development of new, better, and cheaper construction methods. The Forest Products Laboratory of the Department of Agriculture is assisting in the program by testing parts fabricated from wood.

#### NEW AND REVISED PUBLICATIONS ISSUED DURING DECEMBER 1937

##### Journal of Research<sup>2</sup>

Journal of Research of the National Bureau of Standards, volume 19, number 6, December 1937 (RP1050 to RP1058, inclusive). Price 25 cents. Annual subscription, 12 issues, \$2.50.

##### Research Papers<sup>2</sup>

[Reprints from September and October 1937 issues of the Journal of Research]

RP1026. Optical specification of light-scattering materials. Deane B. Judd. Price 10 cents.

RP1031. Study of Transparent plastics for use on aircraft. Benjamin M. Axilrod and Gordon M. Kline. Price 15 cents.

RP1033. Separation of the three methyl-octanes from midcontinent petroleum. Joseph D. White and Augustus R. Glasgow, Jr. Price 5 cents.

RP1037. Journal-bearing design as related to maximum loads, speeds, and operating temperatures. Samuel A. McKee. Price 5 cents.

RP1038. Estimation of amino nitrogen in insoluble proteins. Henry A. Ruthenford, Milton Harris, and Arthur L. Smith. Price 5 cents.

RP1039. X-ray diffraction patterns of sol, gel, and total rubber when stretched, and when crystallized by freezing and from solutions. George L. Clark, Enno Wolthuis, and W. Harold Smith. Price 10 cents.

##### Circulars<sup>2</sup>

C415. Magnetic testing. (Supersedes C17.) Raymond L. Sanford. Price 10 cents.

##### Handbooks<sup>2</sup>

H21. Code for protection against lightning (Parts I, II and III). (Supersedes M92 and H17.) Price 15 cents.

##### Simplified Practice Recommendations<sup>2</sup>

R30-37. Roofing ternes. (Supersedes R30-28.) Price 5 cents.

##### Commercial Standards<sup>2</sup>

CS62-38. Colors for kitchen accessories. Price 5 cents.

(See footnotes on p. 12.)

CS63-38. Colors for bathroom accessories. Price 5 cents.

#### Miscellaneous Publications

M160. Visitors' manual of the National Bureau of Standards. (Supersedes M153.) Hugh G. Boutell. Free on application to the Bureau.

#### Technical News Bulletin<sup>2</sup>

Technical News Bulletin 248, December 1937, with annual index. Price 5 cents. Annual subscription, 50 cents.

#### MIMEOGRAPHED MATERIAL

##### Letter Circulars

Letter circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or to send copies automatically as issued.

LC508. Odorous fumes from sulphate pulp mills.

LC509. Railway track scale testing service of the National Bureau of Standards, fiscal year 1937 (July 1, 1936 to June 30, 1937).

#### Technical Information on Building Materials

The supply of these notes, each of which consists of three or four pages giving the important facts on some one aspect of the properties or use of building materials, is necessarily limited. Their distribution will be confined to Government officials concerned with building projects and to architects, engineers, and home builders. Requests should make clear the actual need for the information at the time of writing. Letters should be addressed to the Division of Codes and Specifications, National Bureau of Standards, Washington, D. C. The following note was issued since the December 1937 number of the Technical News Bulletin was printed:

TIBM-58. Masonry wall resistance to rain penetration.

<sup>2</sup>Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, \$2.50 per year (United States and its possessions, and Canada, Cuba, Mexico, Newfoundland, and the Republic of Panama); other countries, 70 cents and \$3.25, respectively.

#### RECENT BUREAU ARTICLES APPEARING IN OUTSIDE PUBLICATIONS<sup>3</sup>

Sudden disturbances of the ionosphere. J. H. Dellinger. J. Applied Physics (American Institute of Physics, 175 Fifth Ave., New York, N. Y.) 8, 732 (November 1937).

Dentists rely on standards. Wilmer Souder. Ind. Stdzn. and Commercial Stds. Mo. (29 West 39th St., New York, N. Y.) 8, 274 (October 1937).

A specification for tooth paste. Wilmer Souder and Irl C. Schoonover. J. Am. Dental Assn. and the Dental Cosmos (212 E. Superior St., Chicago, Ill.) 24, 1817 (November 1937).

A radiometric method of measuring ultraviolet solar radiation intensities in the stratosphere. W. W. Coblentz and R. Stair. Bul. Am. Meteorological Soc. (Blue Hill Observatory, Milton, Mass.) 18, 345 (November 1937).

Performance characteristics of venturi tubes used in aircraft for operating wind-driven gyroscopic instruments. H. C. Sontag and D. P. Johnson. Technical Note 625 (National Advisory Committee for Aeronautics, Washington, D. C.), (November 1937). (Obtainable from NACA without charge.)

Stress distribution in steel rigid frames. H. L. Whittemore and A. H. Stang. Progress reports 6, 7, 8 (Am. Inst. Steel Construction, 200 Madison Ave., New York, N. Y.) (September 1, 1936, March 23, 1937, and June 5, 1937).

Stress distribution in steel rigid frames. H. L. Whittemore and A. H. Stang. Progress report 9 (Am. Inst. Steel Construction) (September 11, 1937).

Tests to destruction of steel rigid frames. H. L. Whittemore and A. H. Stang. Progress report 10 (Am. Inst. Steel Construction) (October 16, 1937).

Atmospheric corrosion testing. H. S. Rawdon. Paper published as part of book entitled Symposium on Corrosion Testing Procedures (Am. Soc. Testing Materials, 260 S. Broad St., Philadelphia, Pa.) (November 1937).

Some effects of heat treatment on portland cement clinker. William Lerch and W. C. Taylor. Portland Cement Assn. Fellowship, National Bureau of Standards, Washington, D. C.) Paper 33 (July 1937).

The hydrated calcium silicates. E. P. Flint and Lansing S. Wells. Trans. Am. Geophysical Union (National Academy of Sciences, Washington, D. C.), part 1, 261 (December 1937).

<sup>3</sup>These publications are not obtainable from the Government unless otherwise stated. Requests should be sent direct to the publishers.

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